COMPUTE THIS

Background

The loss of the Space Shuttle Columbia during the STS-107 mission on February 1, 2003 was a tragic event for the U.S. manned space flight program. Never before has a U.S. spacecraft been lost during re-entry into the earth's atmosphere, and damage to the heat shield tiles underneath the left wing of the Shuttle Orbiter is a possible cause. It is suspected that a piece of foam insulation broke free from the main Shuttle fuel tank during launch and acted as a projectile that damaged one or more tiles when it struck the underside of the Orbiter on ascent.

Graphical Problem

You have been asked by the Columbia Accident Investigation Board to analyze the results of Orbital Tile Impact Testing performed by the Southwest Research Institute for NASA in 1998 and 1999. During this period, 131 tests were conducted using foam projectiles of different size, fired at different velocities, and at different impact angles to the tiles under test.

Your assignment is to analyze the effect of the largest test projectiles (1" x 1"x 3') that were fired at an impact angle of 23 degrees at varying velocities. Note - This is a small subset of the 131 total tests conducted. Using an X-Y Scatter Chart in MS Excel, please plot the relationship between the velocity of each 1" x 1" x 3" projectile (fired at 23 degrees) to the damage volume of the crater it produced. The x-axis should represent Projectile Velocity (in feet per second) and the y-axis should represent Damage Volume (in cubic inches). Please label each axis carefully, and include a trend line to illustrate the approximate relationship between projectile velocity and damage volume.

Short Answer Questions

In Microsoft Word, please provide the answer and associated URL for each of the following questions. Official NASA web sites should be referenced. Please note that each question requires two separate answers; complete sentences are NOT required.

1. The loss or damage of heat shield tiles has been a problem since the beginning of the Space Shuttle program. During Columbia's maiden flight in 1981 (STS-1), how many tiles were (a) lost and (b) damaged?

2. What is the operating temperature range (minimum to maximum, in degrees Fahrenheit) of the reinforced carbon-carbon tiles used on the underside of the Shuttle's wings?

3. In total, how many missions did Columbia fly, including STS-107? On how many missions did Columbia dock with the International Space Station?

4. At what approximate altitude (in feet) and airspeed (in Mach) was Columbia STS-107 traveling when communication with the orbiter was lost?

5. Where are the two emergency exits located in the Shuttle crew compartment? (please provide a specific short phrase for each answer).

General Instructions

1. Please place your school name and team number at the top of your Excel and Word files.
2. Please name your files (school name).xls and (school name).doc and save them on the diskette provided.

Save your work regularly throughout the event.

3. Your Excel file should include both a spreadsheet data table and an X-Y scatter chart as described above. Your Word file needs to include only the answers and URLs for each of the five questions.
4. Reference materials and calculators are not permitted. You may use blank scrap paper to organize your work.
5. This is a two-person event. Absolutely no external communication with others (e-mail, chat, or other).
6. Please raise your hand if you have a technical problem or question on the event.
7. Please speak in a low tone with your partner. Let us keep the noise level down.
8. When you are done, please save your files and hand in your diskette and signed questions sheet.

GOOD LUCK!!!!

Velocity	Damage Volume
440	0
723	0.29
1356	2.51
1588	2.59
870	0.37
1520	2.02

Source: http://www.jsc.nasa.gov/news/columbia/orbiter_tile_impa(

Short Answer Questions

1. In STS-1 the SRB ignited and resulted in:
   a. the loss of 16 tiles.
   b. the damage of 148 tiles-

Source: http://www-pao.ksc.nasa.gov/kscpao/shuttle/missions/sts-l/mission-gte-Uitml

2. The operating temperature range is from -250 °F to "about" 3000 °F.

Source: http://science.ksc.nasa.gov/shuttle/technology/sts-newsref/stssys.htmltfsts-rcc

3. Columbia flew **28** missions including STS-107.
Source: http://science.ksc.nasa.gov/shuttle/resources/orbiters/columbia.html

It docked with the ISS **three** times.

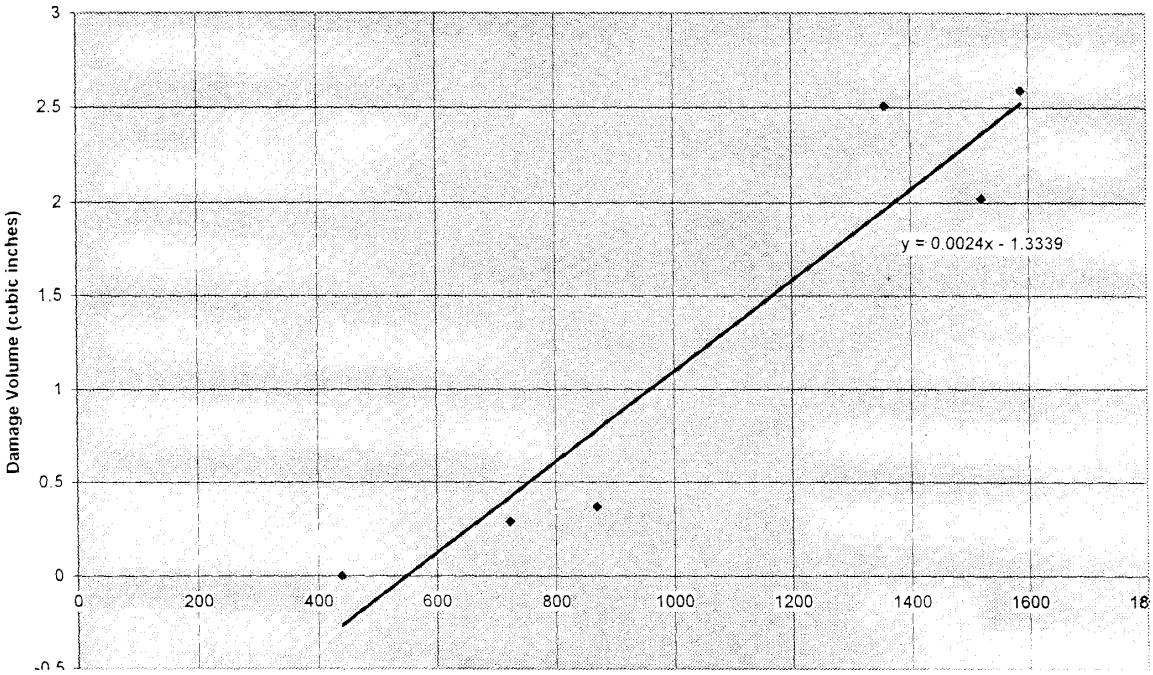
4. Communication with the orbiter was lost at approximately 203,000 **feet** while it was traveling at **Mach** 18.

Source: ftp://ftp.hq.nasa.gov/pub/pao/pressrcl/2003/03-030.txt linked from http://www.nasa.gov/audience/formedia/MP_Archive_2003.html

5. The escape routes for the emergency exit egress system are located through the left overhead window and the side hatch (for mid-air escapes).

Source: http://nasaexplores.com/search_nav_9_l 2.php?id=02-040&al=91_2

Damage Volume Versus Projectile Velocity



Projectile Velocity (feet per second)